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Qualitative Analysis of BSE Risk Factors in the United States

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USDA:APHIS:VS

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Executive Summary

Since 1986, Bovine Spongiform Encephalopathy (BSE) has been diagnosed in over 21,000 cattle, 0.5 percent of the United Kingdom adult cattle population or 9-10 percent of the beef and dairy operations. Almost exclusive to the United Kingdom, new cases currently average 325-350 per week. BSE is an unconventional infectious virus. Current hypotheses suggest that an increase in the exposure of cattle to the sheep scrapie agent via ruminant derived proteins in feedstuffs have led to a detectable incidence of the disease. While BSE is not known to exist in the United States, it is of concern when considering that receipts to farmers from cattle, sheep and related products are roughly $60 billion dollars per year and feed expenses are over $20 billion per year.

This report contrasts the United States and United Kingdom sheep and cattle demographics along with characteristics of the slaughter, feed, and rendering industries. This contrast is followed by an analysis of major similarities and differences in order to arrive at a qualitative assessment of the risk of BSE at the national level.

Within the United Kingdom, a number of key related factors provide possible explanations for a change in contact of cattle to sheep-derived proteins. Sheep numbers increased by 12 million head over the last decade allowing a probable increase in the prevalence of scrapie infected flocks. Increased sheep numbers led to a larger amount of sheep raw material from both fallen and slaughter stock in animal products. In addition, the adoption of a newer continuous rendering technology process along with a drastic reduction in hydrocarbon solvents have led to changes in the manufacturing processes.

Similarities exist in the two countries usage of continuous rendering technology and the lack of usage of solvents, however, large differences still remain with other risk factors which greatly reduce the potential risk at the national level.

The United Kingdom has 4 times as many sheep and 3 times as many ewes on a land mass slightly smaller than the State of Oregon. The higher density of sheep to land along with substantial movement of sheep is conducive to facilitating the spread of scrapie across the sheep population. In the United States, 80 percent of the sheep are in the 17 western States. With predators such as coyotes and large rangeland operations, removal of fallen and diseased sheep stock to be rendered is less complete compared to the specialized United Kingdom "knacker" industry.

The ratio of all sheep to all cattle is 32 times greater in the United Kingdom. Likewise, the ratio of all mature sheep to all milk cows is 10 times larger. Sheep in the United Kingdom account for 14 percent of raw rendering material versus 0.6 percent in the United States. This computes to 3.4 pounds per dairy cow in the United Kingdom versus 2.8 ounces per head in the United States.

Almost all cases have been in dairy herds with 89 percent of cases in cows 4 years and older. In the United States, 53 percent of all dairy cows are less than 4 years of age. In the United Kingdom, 70 percent of all dairy cows are older than 4 years. The United States feeds 41 pounds per 100 pounds of milk produced versus 21 pounds in the United Kingdom. However, for each pound of mature sheep meat and bone meal produced, 17 tons of dairy concentrate are fed in the United States versus 0.4 tons in the United Kingdom. The United States grows an abundance of plant based proteins. The United Kingdom has traditionally imported some 500-600,000 tons of soybeans. Moreover, the portion of animal proteins used as a percent of all other major feed proteins is 6-7 percent greater in the United Kingdom.

While this qualitative analysis suggests the potential risk of BSE at the national level is substantially less, no analysis is made of the variation in the levels of risk across geographic areas of production. Of consideration are factors such as the concentration of mature sheep slaughter and the proximity of rendered products from mature sheep offal to dairy populations. A more indepth quantitative analysis of these and other risk factors are contained in the APHIS:VS Quantitative Risk Assessment of BSE in the United States.

Introduction

Bovine Spongiform Encephalopathy (BSE) is an unconventional infectious virus. Virtually all cases have been in the United Kingdom with new cases currently averaging 325-350 per week. The current hypotheses suggest that an increase in the exposure of cattle to the scrapie agent via ruminant derived proteins in feedstuffs have led to a detectable incidence of the disease. Key related factors provide possible explanations for a change in the contact of cattle to sheep-derived protein. Sheep numbers increased in the last decade suggesting a probable increase in the prevalence of scrapie infected flocks. Increased sheep numbers led to a larger amount of sheep raw material from both slaughter and fallen stock in rendered animal products. Concurrently, cattle numbers trended down decreasing their contribution to total rendered product. The adoption of a newer, continuous rendering process allowed for lower temperature and/or shorter periods of time to be used in the manufacturing process. In addition, the decline in the usage of hydrocarbon solvents and the associated heat treatment used in this process potentially resulted in increased survival of the infectious agent.

The qualitative analysis presented in this report compares and contrasts the United States and United Kingdom sheep and cattle demographics along with characteristics of the slaughter, feed, and rendering industries. Comparisons between the two countries are presented at the aggregate or national level. For each sector, background and demographic information is given followed by a section outlining key differences between the two countries as it relates to BSE. This is followed by a qualitative assessment which syntheses the major similarities and differences in order to arrive at a broad estimate of risk at the national level.

Sheep Population and Practices

For the past 10 years, the sheep populations in the two countries have moved inversely. From a peak of 49 million head in 1942, United States' sheep inventories have trended down (Figure 1). Contributing factors include a shrinking consumer base, a higher relative price compared to other meats, wide price variations from small changes in supply, and a dwindling supply of experienced labor. Based on location and production practices, United States sheep operations can be geographically divided into two categories. First, 80 percent of all sheep are located in the 17 western States (Figure 2). Mostly white-faced breeds, these operations can contain both sheep and cow-calf enterprises. Available range lands constitute a major feed stock. The density of sheep to usable land is low, computed at 1 animal per 10 acres. Second, of the remaining 20 percent of sheep, many are in the upper Midwest. Often small and part-time operations, many of the sheep are black-faced breeds. The upper Midwest contains some of the highest densities of sheep to usable land at 1 animal per 3 acres (Figure 3).

The United Kingdom sheep population is increasing from a 1978-80 average of 30.4 million head to a 1989 inventory level of 42.9 million head (Figure 4). While sheep meat consumption is one-half the level of 20 years ago, less imports and production incentives have acted to increase domestic production. Moreover, the imposition of milk quotas coupled with a price support system whereby one-third of revenues are from non-market sources have boosted the number of combined sheep and dairy operations. Substantial movement of sheep occurs with animals, including ewes, transported from the highlands of Northern England and Scotland to the lowlands further south. In addition there is significant buying, selling, and transportation of sheep to arbitrage price differentials across areas.

Farm Size and Concentration

Although each country has roughly 92,000 sheep operations, the United Kingdom contains 4 times as many sheep with the distribution of sheep across different herd sizes varying significantly (Figure 5). Herd size distribution is even more pronounced in the United States where 50 percent of the sheep operations are of the smallest size category, 1-24 head, which accounts for only 4.5 percent of all sheep. Conversely, only 2 percent of the United States sheep operations are of the largest size category, 1000 + head, which accounts for 51 percent of all sheep. This compares with 55 percent of the United Kingdom sheep operations having between 100 and 1000 head and accounting for 47 percent of all sheep.

Scrapie Disease

Both countries have taken different approaches to sheep scrapie disease. The United States has employed indemnity payments and encouraged reporting as control measures. Scrapie has been reported in 35 States with most of the reported cases in the black-faced breeds (Figures 6 and 7). The reporting of scrapie has been notably influenced by the real (inflation adjusted) value of the indemnity payment (Figure 8). The 1980-90 cumulative reported incidence of scrapie is 7.5 flocks per 1000 flocks, with substantial intrastate variation.

With scrapie endemic for at least two hundred years, the United Kingdom has no national movement to encourage the control or reporting of the disease. Even though prevalence estimates are suspect, the results suggest that scrapie is common within all breeds. Further, the total number of all cases is substantially greater in the United Kingdom versus the United States.

Key Factors

During the 1980's, the two countries' sheep populations moved inversely. The United Kingdom now has 4 times as many sheep and lambs and more importantly about 3 times as many mature sheep or sheep greater than 1 year old (Figure 9). This increase in the number of sheep in the United Kingdom allowed for a probable increase in the prevalence of scrapie flocks. The result was more infected sheep material from slaughter and dead stock available for usage in animal protein products.

Unlike the United States where 50 percent of the sheep are on 2 percent of the farms, the United Kingdom has 47 percent of the sheep on one-half of the farms. This supports a more active market to buy, sell, and move stock sheep across the United Kingdom. This also facilitates a potential spread of scrapie across the population.

Figure 1

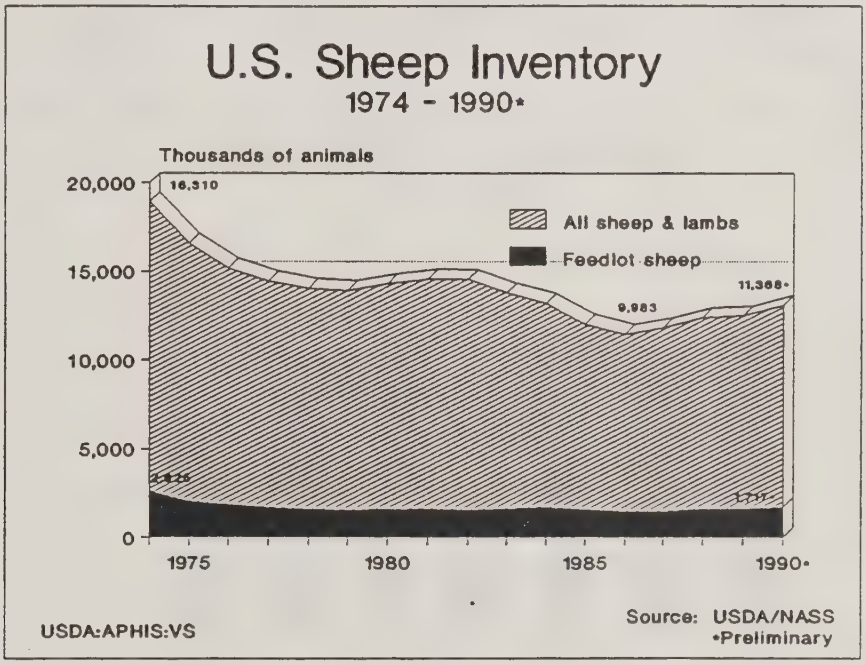


Figure 2

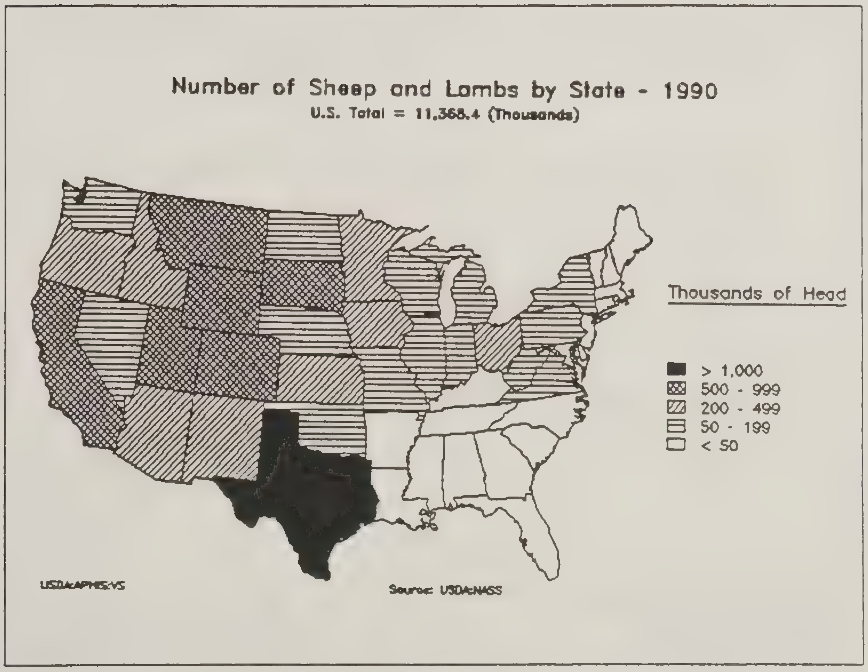
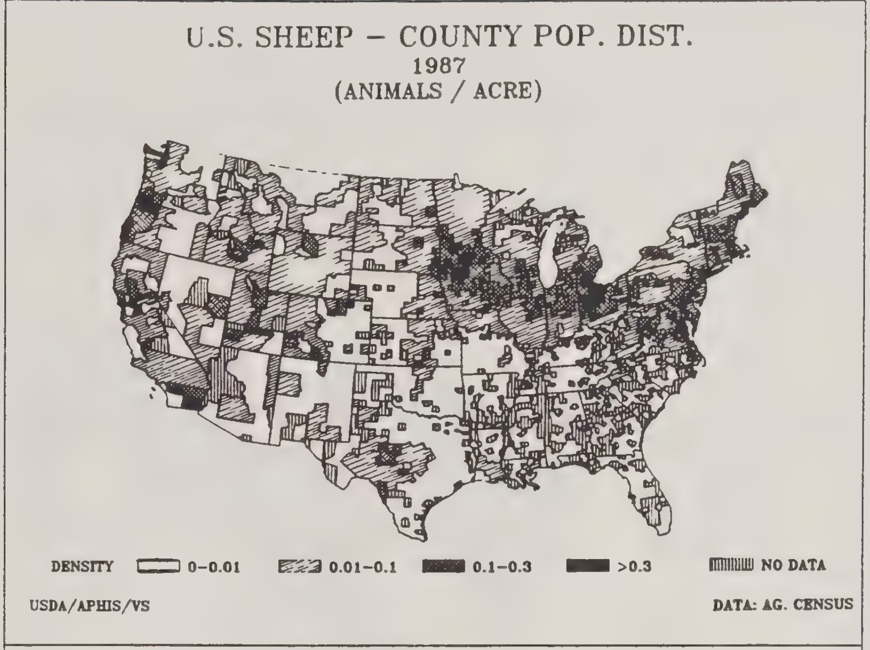


Figure 3

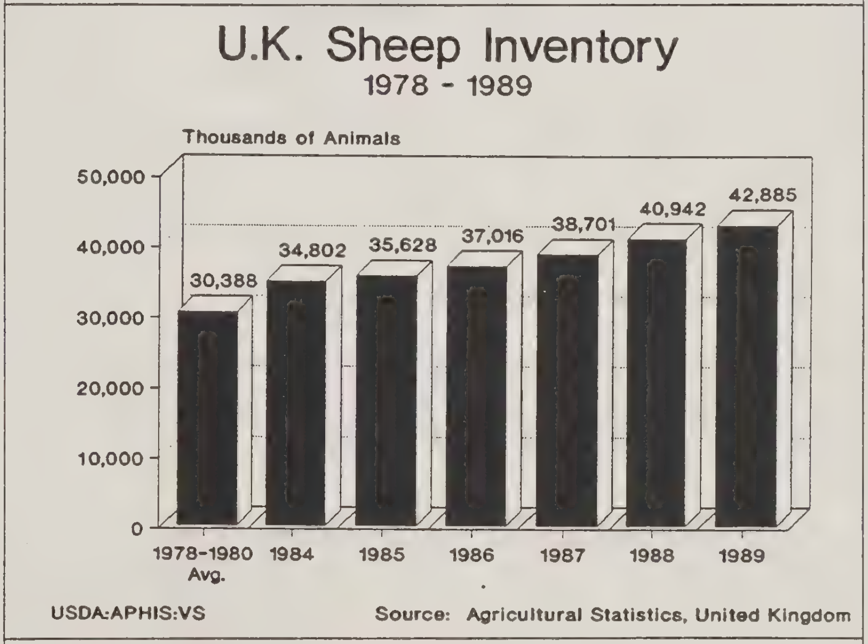


U.S. SHEEP – COUNTY POP. DIST.
1987
(ANIMALS / ACRE)

USDA/APHIS/VS

DATA: AG. CENSUS

Figure 4



U.K. Sheep Inventory
1978 - 1989

USDA:APHIS:VS

Source: Agricultural Statistics, United Kingdom

Figure 5

U.K. & U.S. Comparison of Sheep Numbers and Farms by Herd Size - 1989

Herd Size (# head)	% of Sheep U.S.	% of Sheep U.K.	% of Farms U.S.	% of Farms U.K.
1-24	4.5	.3	50.0	11.0
25-99	13.5	2.7	34.0	21.0
100-299	14.0	11.4	10.0	27.0
300-999	16.7	35.4	4.0	28.0
1000 +	51.3	50.2	2.0	13.0

Source: U.S. Ag Census
U.S. Ag Statistics
MAFF, United Kingdom

USDA:APHIS:VS

Figure 6

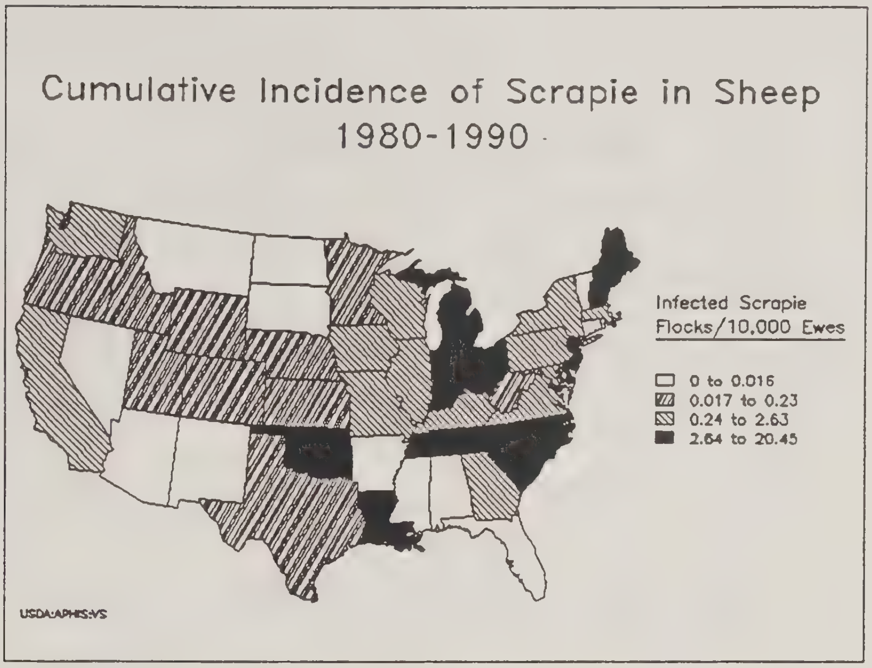


Figure 7

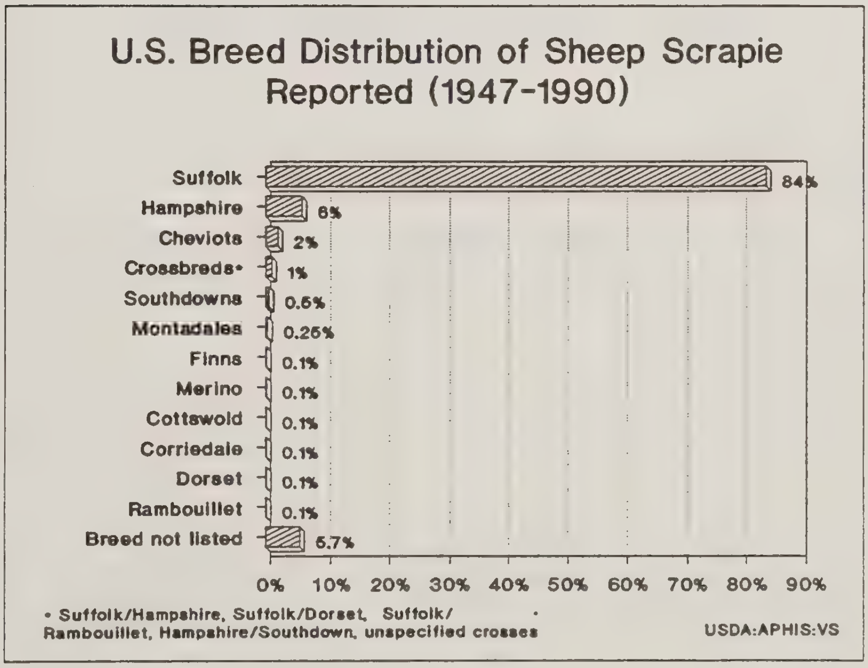
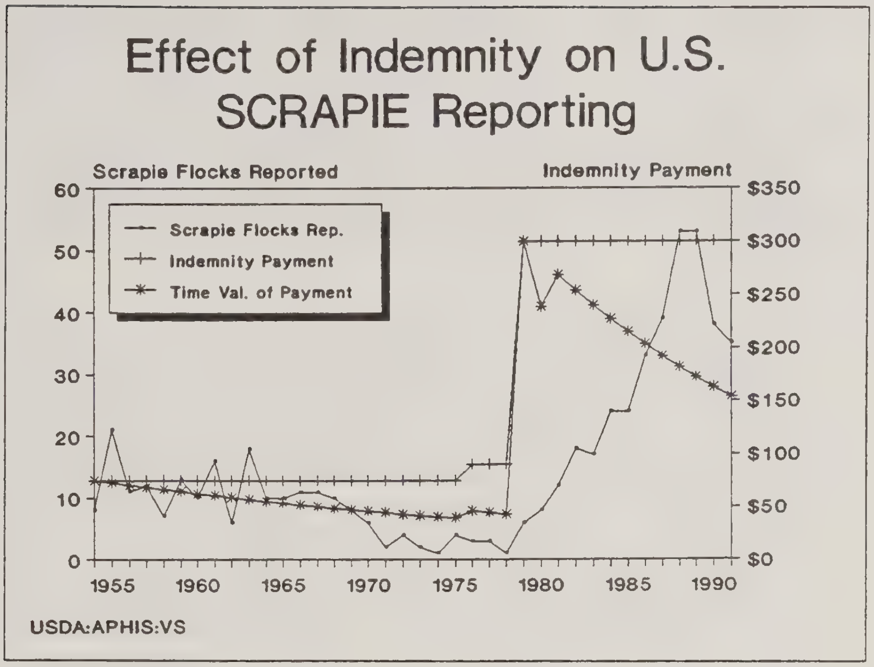


Figure 8



Effect of Indemnity on U.S. SCRAPIE Reporting

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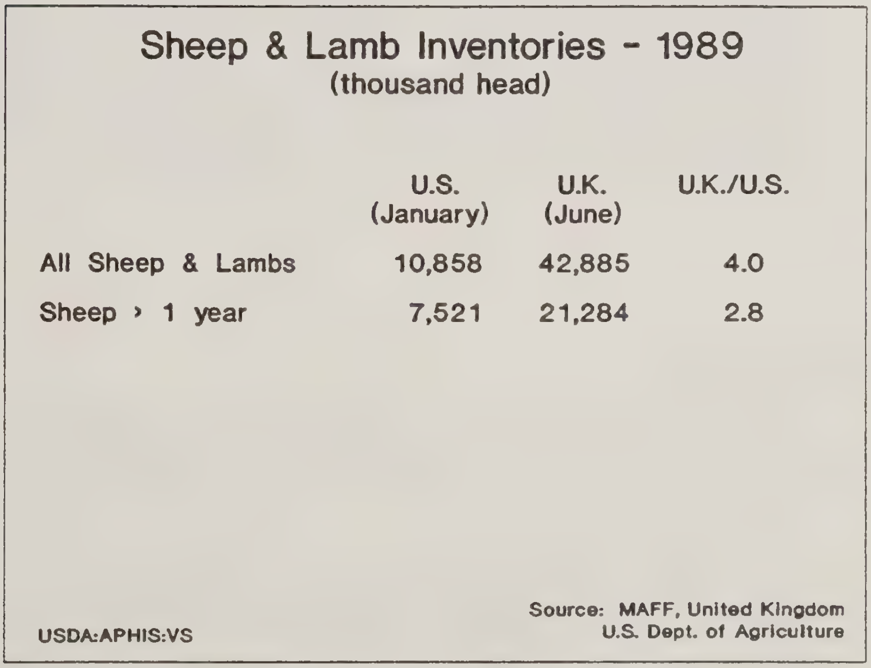
Figure 9



Sheep & Lamb Inventories - 1989
(thousand head)

	U.S. (January)	U.K. (June)	U.K./U.S.
All Sheep & Lambs	10,858	42,885	4.0
Sheep › 1 year	7,521	21,284	2.8

USDA:APHIS:VS

Source: MAFF, United Kingdom
U.S. Dept. of Agriculture

Cattle Inventories and Practices

Similar to sheep, cattle production has varied significantly within the two countries. Although the number of cattle have declined by 2 million head per year since 1975, the United States still maintains more than 8 times as many cattle (Figures 10 and 11) as the United Kingdom (Figure 12). Concentrate feeding remains an important practice with 75 percent of all cattle slaughtered having spent time in a feedlot. At 12 million head, the United Kingdom beef numbers have declined by 1.5 million head in the last 10 years. Unlike the United States where per capita beef consumption has dropped almost 6 pounds since 1987, the United Kingdom household consumption has remained relatively unchanged and reports of drastic decline in beef demand have been exaggerated.

The number of dairy cows in both countries have declined but for different reasons. At 10.1 million head versus 2.9 million head, the United States has 3.5 times more cows. In the United States, per cow and total milk production have more than offset the decline in cow numbers (Figures 13 and 14). Milk support policies, genetic advances and more intensive management have encouraged the culling of older cows and the feeding of concentrates in the United States (Figure 15). Compared to the United Kingdom, dairy cows in the United States are on average 1.3 years younger, produce 5,000 more pounds of milk and consume 1.8 additional tons of concentrate feeds (Figure 16). Cow numbers in the United States are disproportionate to the herd size distributions. The smallest herd size category, 1-29 head, contains 45 percent of the farms but only 7 percent of the cows. The highest category, 200+ head, contains only 2 percent of the farms but 24 percent of the cows (Figure 16).

The decrease in the United Kingdom dairy cow numbers of about 400,000 over the last ten years has been notably influenced by the imposition of dairy milk production quotas. A slight gain in per cow milk production has not been sufficient to compensate for the decline in cow numbers causing total milk production to decline. Unlike the United States, dairy, beef, and/or sheep are often combined operations with little concentrate fed. Roughly two-thirds of eventual cattle slaughter originate from dairy stock and approximately 5-7 percent of cows in cow-calf herds are culled dairy cows. Milk quotas have boosted the number of sheep raised with dairy. For England and Wales, 72 percent of sheep operations contain 81 percent of all sheep and 50 percent of all cattle (Figure 17). Compared to the United States, herd size distribution is more proportional across herd size classes in the United Kingdom.

Key Factors

The distribution by breed and functional type (Figure 18) indicates that 98 percent of all reported BSE cases in the United Kingdom have been in dairy herds. The proportion of cases is similar to the breed distribution and suggests no predisposition by breed to disease.

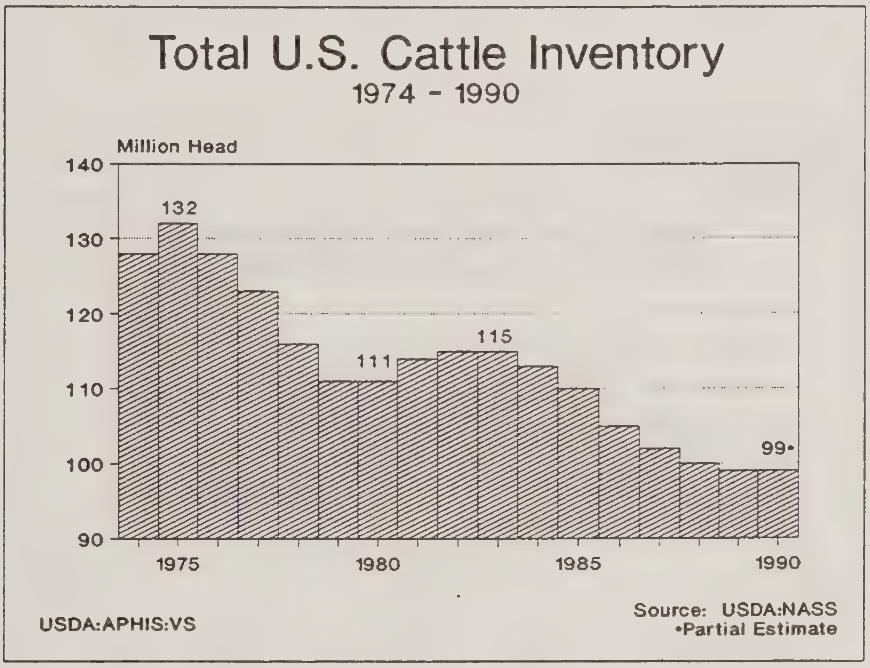
Compared to the United Kingdom, United States dairy production is more intensive, using less grass and more concentrate feeds. Concentrates fed per cow ranges from 1.9 tons to over 5 tons. The sourcing and relative quantities of protein components in concentrates varies considerably depending on geographic location and prices of substitutes.

Of critical importance are the relative age distributions. Fifty-three percent of the United States dairy cows are less than 4 years of age, whereas, 70 percent of the United Kingdom's dairy cows are greater than 4 years and have accounted for 89 percent of the BSE reported cases. In 1989, the occurrence of BSE in cows 2-3 years of age was approximately 12 cases per 10,000 cows (Figure 19). For cows greater than 4 years, the range was from 59 cases per 10,000 cows for age 7 and older to 288 cases per 10,000 for cows of age 5.

At 329 affected herds per 10,000 herds, herds containing 200 or more head (Figure 16) are at greatest risk of BSE in the United Kingdom. This compares with 14 herds per 10,000 herds for herds of less than 50 head. The United Kingdom has 9 percent of all dairy cows in the largest herd size category versus 24 percent in the United States.

The ratio of all sheep to all cattle is 32 times greater in the United Kingdom versus the United States. Because of the extended incubation period, sheep greater than 1 year of age are of primary concern for scrapie disease. In this case, the ratio of all sheep greater than 1 year to all beef and milk cows is 29 times greater in the United Kingdom. For mature sheep to milk cows, the ratio is 10 times greater in the United Kingdom (Figure 20).

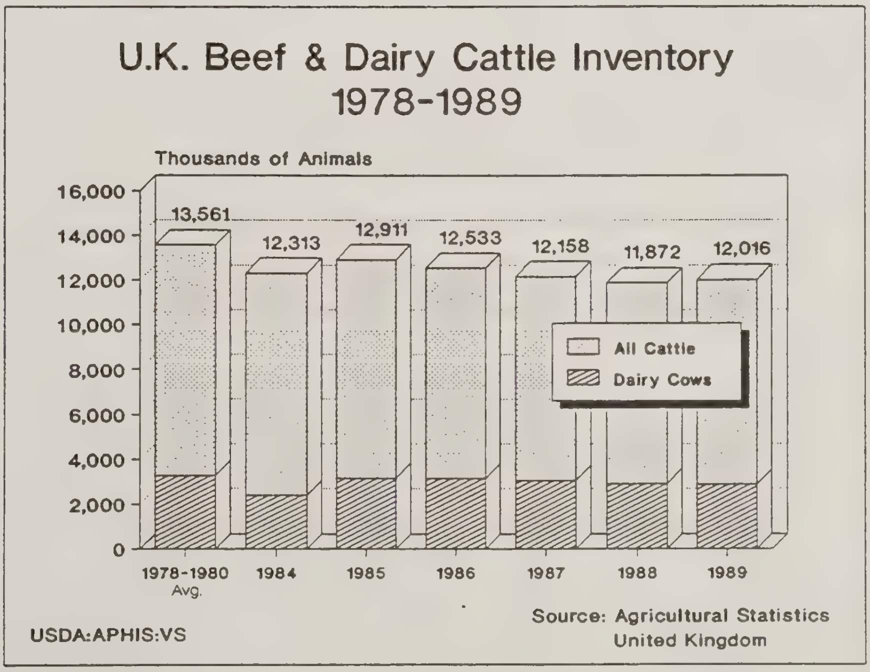
Figure 10



USDA:APHIS:VS

Source: USDA:NASS
•Partial Estimate

Figure 11



USDA:APHIS:VS

Source: Agricultural Statistics
United Kingdom

Figure 12

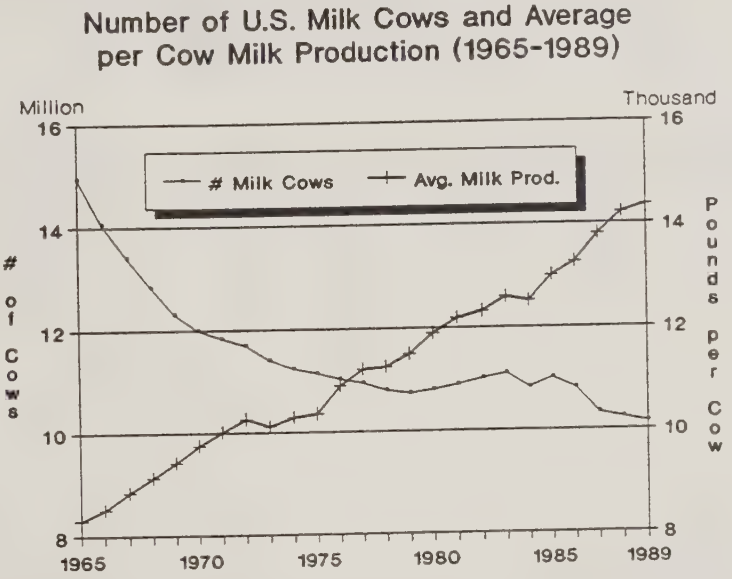
Cattle & Calf Inventories
(thousand head)

	U.S. (1990)	U.K. (1989)
All Cattle and Calves	99,337	12,016
Beef Cows	33,705	1,495
Milk Cows	10,149	2,867
Heifers, Steers, Bulls, and Calves	55,484	7,654

USDA:APHIS:VS

Source: MAFF, United Kingdom
U.S. Dept. of Agriculture

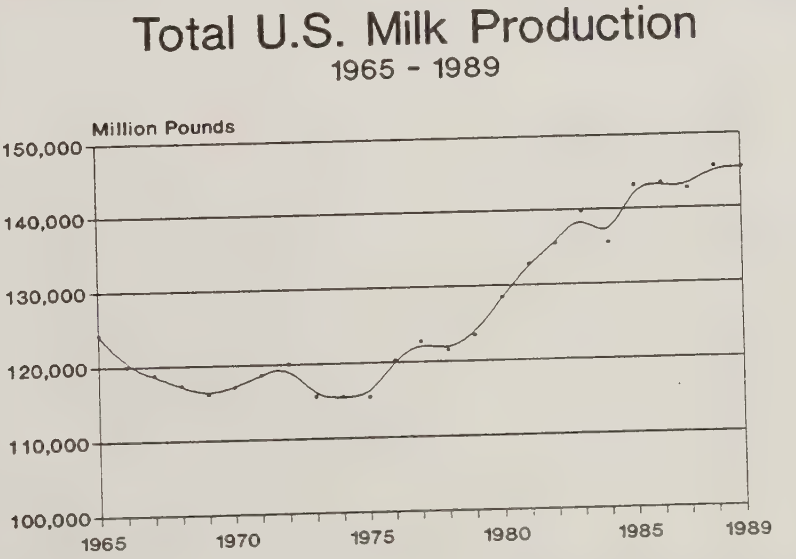
Figure 13


Number of U.S. Milk Cows and Average per Cow Milk Production (1965-1989)

USDA:APHIS:VS

Source: USDA:NASS

Figure 14


Total U.S. Milk Production
1965 - 1989

USDA:APHIS:VS

Source: USDA:NASS

Figure 15

Dairy Cow Inventories, Average Milk Production and Concentrate Fed

	U.S. (1990)	U.K. (1989)
Dairy Cows (thousand head)	10,149	2,867
Average Milk Production (lbs/yr)	14,244	9,448
Concentrate Fed (lbs/yr)	5,800	2,180

Source: Agricultural Statistics & MAFF, United Kingdom, U.S. Dept. of Agriculture

USDA:APHIS:VS

Figure 16

Comparison of Herds, Cows and U.K. BSE Cases by Herd Size - 1988

Herd Size (# of head)	U.S.		U.K.		U.K. BSE• case herds/ 10,000 herds
	% herds	% cows	% herds	% cows	
1-29	45	7	27	6	14
30-49	23	18	23	15	
50-99	23	32	34	39	72
100-199	7	19	14	30	193
200+	2	24	2	9	329

•As of April 1988

Source: Ag. Statistics United Kingdom The Veterinary Record (12/17/88) U.S. Dept. of Agriculture

USDA:APHIS:VS

Figure 17

Sheep and Cattle Operations

	U.S. (1988)	U.K. (1989)
Number of Sheep Operations	92,489	91,296
Number of Cattle Operations	1,176,346	70,378
Number of Dairy Operations	202,068	47,935
Percent of Sheep Operations with Cattle	58%	72%•
• Percent of all Sheep within Combined Operations	59%	81%•
• Percent of all Cattle within Combined Operations	4.5%	50%•

•Data for England and Wales only.

Source: MAFF, United Kingdom U.S. Dept. of Agriculture

USDA:APHIS:VS

Figure 18

U.K. Distribution of BSE Confirmed & Suspect Cases* by Breed & Functional Type

Breed	Dairy Cows	Beef Cows
Friesian/Holstein	662	0
Ayrshire/3/4 Ayshire	11	0
Guernsey/3/4 Guernsey	18	0
Hereford x Friesian	0	12
Devon x Friesian	0	1
Jersey x Friesian	1	0
Shorthorn	1	0
Shorthorn x Danish Rd	1	0
Jersey	2	0
Charolais	0	1

*As of April 1988

USDA:APHIS:VS

Source: MAFF, United Kingdom

Figure 19

Age Distribution of Dairy Cows
U.K. Occurrence of BSE - 1989

Age	Age Distribution (%) U.S.	Age Distribution (%) U.K.	U.K. BSE Occurrence % of cases	U.K. BSE Occurrence #cases per 10,000 cows
2 year old cows	31	10	.4	5
3 year old cows	23	20	11	7
4 year old cows	17	18	38	276
5 year old cows	12	16	35	288
6 year old cows	8	12	13	131
7+ year old cow	9	24	3	59
Average Age (years)	3.8	5.1		

USDA:APHIS:VS

Source: MAFF, United Kingdom
U.S. Dept. of Agriculture

Figure 20

Animal Populations

	U.S. (1989)	U.K. (1989)	U.K./U.S.
• Ratio of ALL SHEEP to ALL CATTLE	.11	3.6	32.7
• Ratio of ALL SHEEP to Milk Cows	1.1	15.0	13.6
• Ratio of ALL SHEEP › 1yr to ALL Beef & Milk Cows	.17	4.9	28.8
• Ratio of ALL SHEEP › 1yr to ALL Milk Cows	.74	7.4	10.0

USDA:APHIS:VS

Source: MAFF, United Kingdom
U.S. Dept. of Agriculture

Slaughter Industry

As expected, the United States slaughters and produces 10 times more cattle and meat as the United Kingdom (Figure 21). For sheep however, the United Kingdom slaughters 3.5 times as many animals and 5.5 times as many ewes. At 843 million pounds, total sheep slaughter is 2.5 times greater than in the United States (Figure 22). Moreover, the numbers do not reflect the 300 million tons of imports some of which are live animals from the Irish Republic for slaughter in the United Kingdom.

Key Factors

The structure of the United States slaughter industry is more specialized with a large portion of the total supply originating from plants customized for specific species. Of the 4,500 commercial slaughter plants in the United States, 97 percent of slaughter comes from 1,300 federally inspected plants. In the United Kingdom, there are approximately 700 slaughter plants with 200 plants accounting for 85 percent of the total slaughter. Although some plants are species specific, many plants accommodate sheep, cattle, and swine which reflects the fluid movement and sale of animals around the country. There are only some 50 plants which contain inspectors and are licensed for export.

In the United Kingdom, 60 percent of the sheep slaughter occurs in the last 2 quarters and 18 percent in the 2nd quarter. In the United States only slight variation occurs over the four quarters. Cattle slaughter across quarters is fairly constant for both countries.

Concentration at point of slaughter is more pronounced in the United States. In 1989, eleven plants, each of which slaughtered more than 100,000 head, accounted for over 80 percent of total lamb slaughter (Figure 23). Twenty-four plants, each of which slaughtered more than 3,000 head, accounted for over 80 percent of total slaughter of sheep greater than one year old.

Figure 21

U.S. & U.K. Sheep & Cattle Slaughter - 1989

	U.S.	U.K.
• All Cattle Slaughtered (thousand head)	36,330	3,667
✓ Average Dressed Carcass Weight (lbs)	683	634
✓ Total Production (million lbs)	23,098	2,127
• All Sheep Slaughtered (thousand head)	5,572	20,338
✓ Total production (million lbs)	348	843•
• Ratio of Cattle to Sheep Slaughter (lb basis)	66	2.5

•Does not include live animals imported from Irish Republic for slaughter.

USDA:APHIS:VS

Source: MAFF, United Kingdom
U.S. Dept. of Agriculture

Figure 22

Number & Age of Sheep Slaughter 1989

	U.S.	U.K.
All Sheep Slaughter (thousand head)	5,572	20,338
• Lamb Slaughter	5,225	18,398
• Mature Sheep	347	1,940
• Slaughter Ratio of Lamb to Ewe	15	9.5
Average Dressed Weights (lbs)		
• Lambs	58	40
• Mature Sheep	64	47
Mature Sheep as a Proportion of Total Dressed Weight	6.8%	11.0%

USDA:APHIS:VS

Figure 23

1989 Geographic Distribution of Plants Accounting for 80 Percent of Sheep & Lamb Slaughter

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Rendering Industry

The rendering industries in both countries continue to undergo substantial structural adjustment. The current number of inedible renders in the United States is approximately 331, down from 990 in 1978. The decline of roughly 50 operations per year is attributable to several factors including changes in technology and slaughter industry practices. The older and more resource intensive batch rendering process is largely being replaced by a more efficient continuous processing technology. With the exception of some large poultry rendering operations, most of the rendering capacity uses the newer continuous rendering process. Prior to the mid 1970's, petroleum based solvents were used to further separate solids from oils, producing meat and bone meal with a 1-2 percent fat content. The increased price of oil corresponding with a market acceptance of a higher fat content has resulted in a virtual phaseout of solvents in the production process. Variation in product quality is more a function of management expertise than technology used. Because meat and bone meal is a small component of all protein sources, it is priced based on competing products such as soybean meal.

Two-thirds of the 45 rendering plants in the United Kingdom use the older batch process but account for only one-fourth of total output. The remaining 75 percent is produced at 15 plants. One firm operates 5 plants and accounts for 50 percent of the total output. Continuous processing technology was introduced in the 1970's and the usage of solvents declined to about 10 percent of total output by the early 1980's (Figure 24). The adoption of newer production technologies and the change in solvent usage appears to lag the United States by at least 5 years.

Key Factors

There are two important structural distinctions between the two countries (Figure 25). A "knacker" industry primarily handles the pick-up of dying and fallen stock from which a product called "greaves" is made. Greaves is either sold as pet food or purchased by renders to be combined with other animal raw materials for processing. The second important distinction is the movement of raw materials (before processing) and/or greaves among different renders. This is attributed in part to the geographic proximity of the plants, relative production efficiencies, and end product requirements. For example, the pet food industry sources specific types of organs and tissues from only certain species.

Figure 26 compares animal protein production for the two countries. The calculations are based on slaughter numbers, fallen stock estimates, and product yield coefficients. This approach is used due to variation of up to 80 percent from different reported sources. At 3.6 million tons, the United States produces 8 times more animal rendered product than the United Kingdom.

The risk of introducing the BSE agent through sheep meat and bone meal is more acute in both relative and absolute terms in the United Kingdom (Figures 27 and 28). Note that sheep meat and bone meal accounts for 14 percent, or 61 thousand tons, in the United Kingdom versus 0.6 percent or 22 thousand tons in the United States. For sheep greater than 1 year, this is less than one-tenth of one percent of the United States supply.

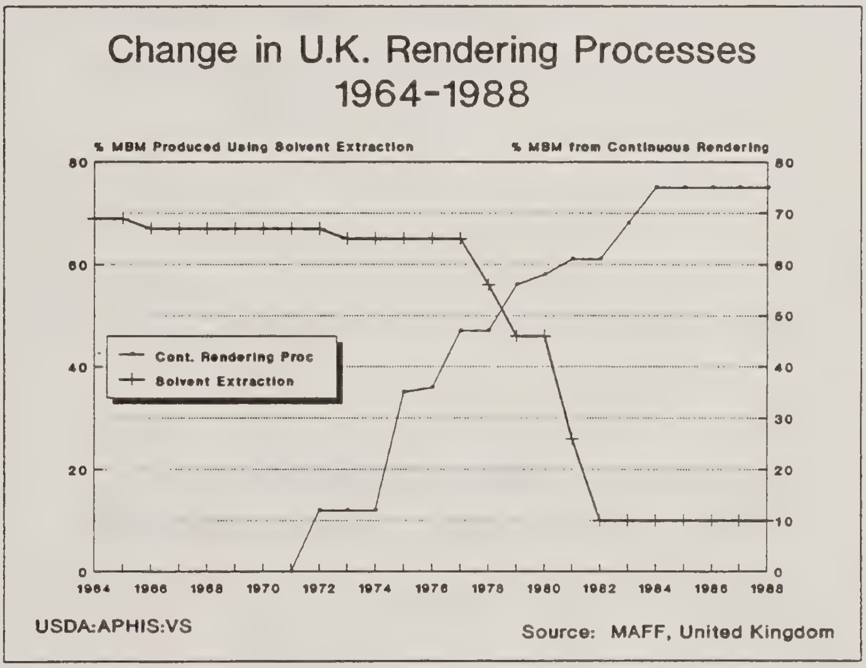
The potential risk of amplification of the BSE agent through cattle meat and bone meal is much greater in the United States where it accounts for 59 percent of total product or almost 5 times more than the total amount of rendered product in the United Kingdom.

An estimate of the distribution of rendered product by species is shown in Figure 29. Prior to the United Kingdom's ban on feeding ruminant products to ruminants, 10-20 percent of rendered products went to cattle. The United Kingdom has been a net exporter of animal protein shipping up to 5 percent of total supply.

In the United Kingdom there is much concern for a specific continuous rendering technology which uses lower temperatures and accounts for 25 percent of total output. This technology was originally designed and imported from the United States. However, the specific application in the production process is believed to be different in the two countries.

The application of solvent in the production process requires an additional reheating of product in order to burn off any remaining solvent residues. Whether it is the application of solvent or the reheating of product that may reduce any potential infectivity is uncertain. If all mature sheep meat and bone meal were fed to dairy cows it would amount to 3.4 pounds per cow per year in the United Kingdom and 2.8 ounces per cow in the United States.

Figure 24

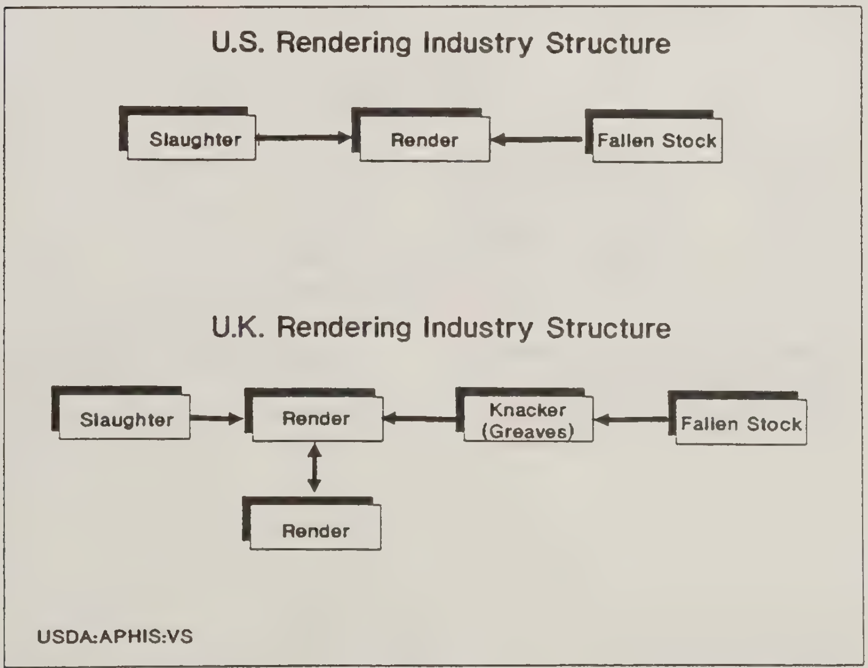


Change in U.K. Rendering Processes 1964-1988

USDA:APHIS:VS

Source: MAFF, United Kingdom

Figure 25



U.S. Rendering Industry Structure

U.K. Rendering Industry Structure

USDA:APHIS:VS

Figure 26

Animal Protein Rendered Production - 1989

(less blood, feather, and fish meal)

	U.S.	U.K.
Total Rendered Product (thousand tons)	3,648	438
Portion from Cattle Slaughter (%)	59	43
Portion from Hog Slaughter (%)	20	25
Portion from Poultry Slaughter (%)	21	18
Portion from All Sheep Slaughter (%)	0.6	14

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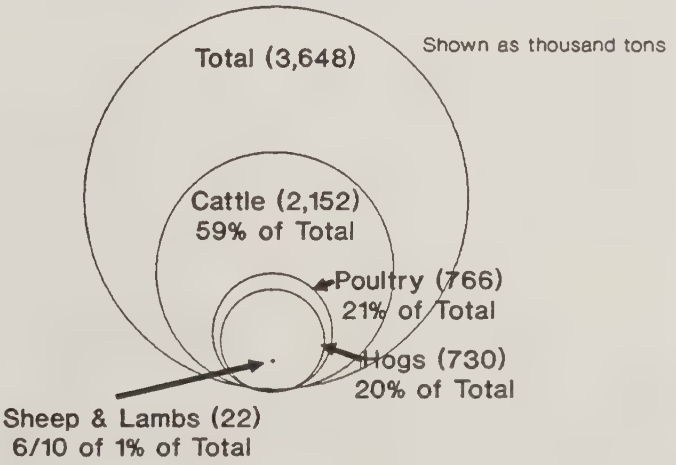
Figure 27

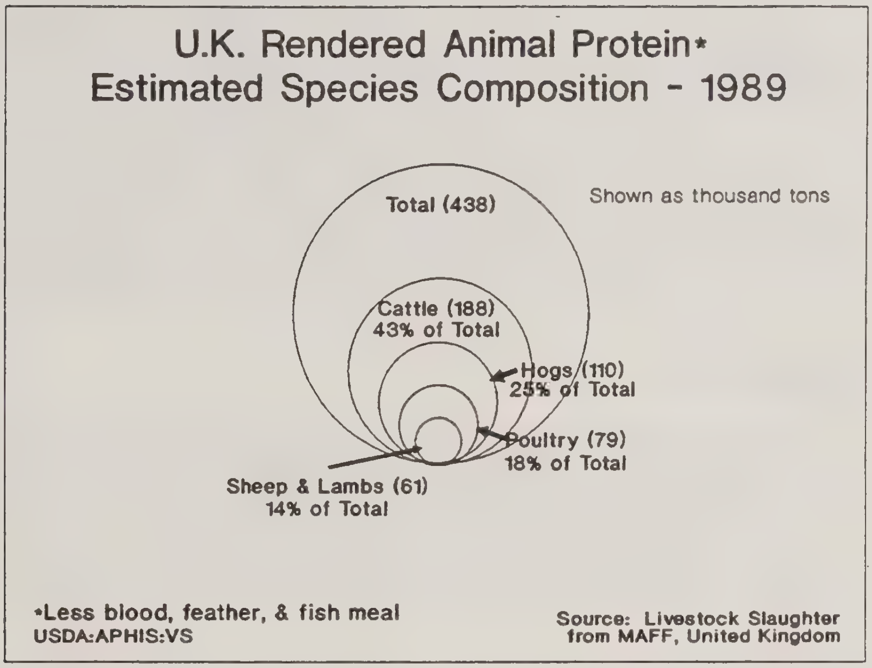
U.S. Rendered Animal Protein*
Estimated Species Composition - 1989



*Less blood, feather, & fish meal
USDA:APHIS:VS

Sources: U.S. Dept. of Agriculture
U.S. Dept. of Commerce
National Rendering Assoc.

Figure 28



U.K. Rendered Animal Protein*
Estimated Species Composition - 1989

*Less blood, feather, & fish meal
USDA:APHIS:VS

Source: Livestock Slaughter from MAFF, United Kingdom

Figure 29

Distribution Estimate of Animal Rendered Proteins (percent) - 1989

	U.S.	U.K.
Pet Food	34	10
Poultry	34	45
Hogs	17	40
All Cattle	13	0*
Miscellaneous	2	5

*Prior to BSE restrictions of July 1988, the portion going to cattle was 10-20 percent.

USDA:APHIS:VS

Because of the relative abundance of protein sources, the usage of concentrates in the United States continues to increase over roughage and pasture (Figure 30). The bulk of concentrates fed are feed grains with very little food grains used (Figure 31). Almost all animal proteins fed to livestock and poultry start as a component of primary concentrate mixes (Figure 32). These feeds often form the basis for additional concentrate feeds. Meat and bone meal accounts for about 3 percent of primary concentrate tonnage (Figure 33) and 1.5 percent of the reported 183 million tons of concentrates fed in 1988 (Figure 34).

The United Kingdom livestock production system is largely grass and roughage oriented. Figure 35 contrasts concentrate production with animal inventories. Of the almost 11 million tons of raw materials used in concentrates for 1988, over 5 million tons were from food grains such as wheat and barley. The United Kingdom imports 500-600,000 tons of soybeans per year.

Key Factors

Whereas 75 percent of cattle slaughter and 65 percent of sheep slaughter pass through feedlots in the United States, sheep and cattle in the United Kingdom receive much less concentrates. For dairy, the United States averages 41 pounds of concentrate fed per 100 pounds of milk produced. For the United Kingdom, the average is 21 pounds. Herd size and the number of farms is more skewed in the United States with average concentrates fed per cow varying as much as 3 tons across some States.

Feed formulation in both countries are driven by least cost considerations subject to nutrient requirements. In terms of usage, Figure 36 shows that animal proteins as a percent of major protein substitutes have been 6-7 percent higher in the United Kingdom. It appears that palatability considerations have tempered additional usage of meat and bone meal in the United Kingdom. In the United States, the price for meat and bone meal tracks closely with soybean meal with the latter about $50-60 per ton less. In the United Kingdom, the price of meat and bone meal over the past 3 years has declined. The current price of $210 per ton is now less than the United States price of $220.

An important difference in the two countries' feeding practices has been the inclusion (prior to the animal protein ruminant feed ban) of meat and bone meal in calf starter and other calf feeds in the United Kingdom. Calves were typically fed 55-65 pounds of calf starter potentially containing up to 4 percent meat and bone meal and/or blood meal. This amounted to roughly 2.3 pounds of meat and bone meal over a 12 week period. The feeding of meat and bone meal in calf starter in the United States is not believed to occur.

A worst case scenario denoting the highest potential risk would be to add all meat and bone meal produced from mature sheep offal to dairy concentrate feeds. The ratio of dairy concentrate fed to mature sheep meat and bone meal produced forms a measure of relative risk between the two countries. The higher the ratio the greater the dilution of total feed to sheep meat and bone meal produced and the less the risk. For the United States, the ratio is 34,760:1 or over 17 tons of dairy concentrate are fed to each 1 pound of sheep meat and bone meal produced. For the United Kingdom the ratio is 778:1, a difference of 45.

Figure 30

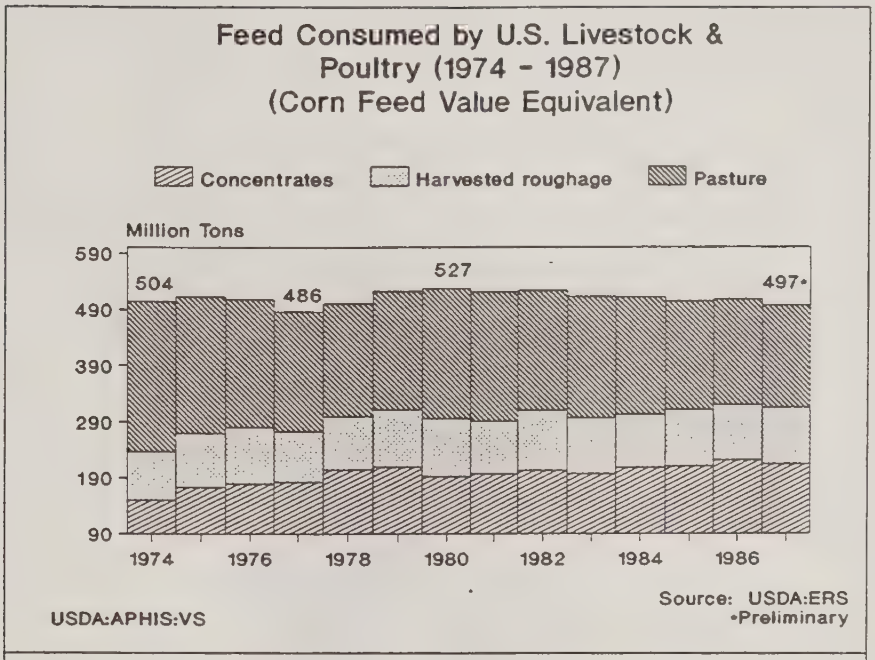


Figure 31

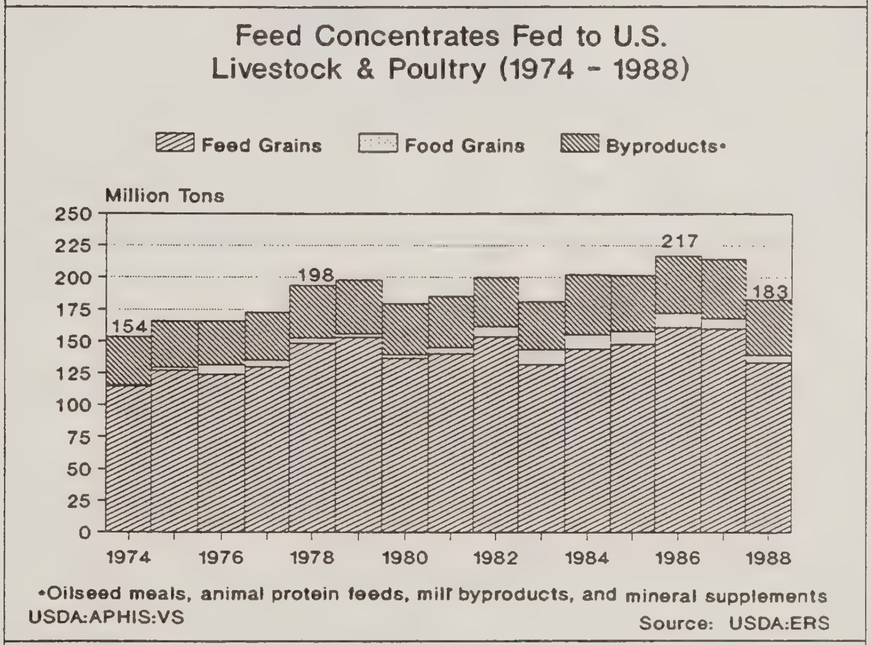


Figure 32

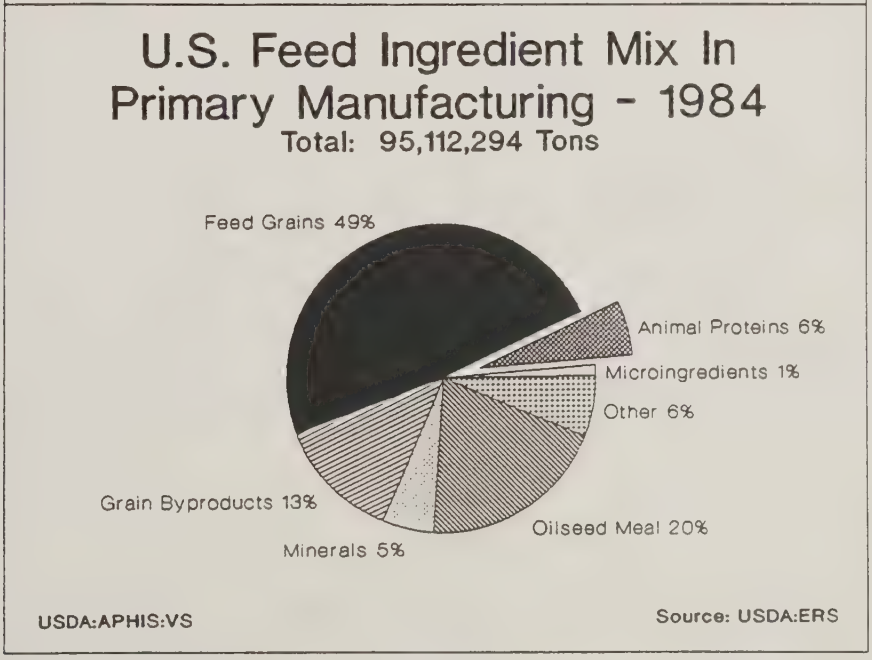
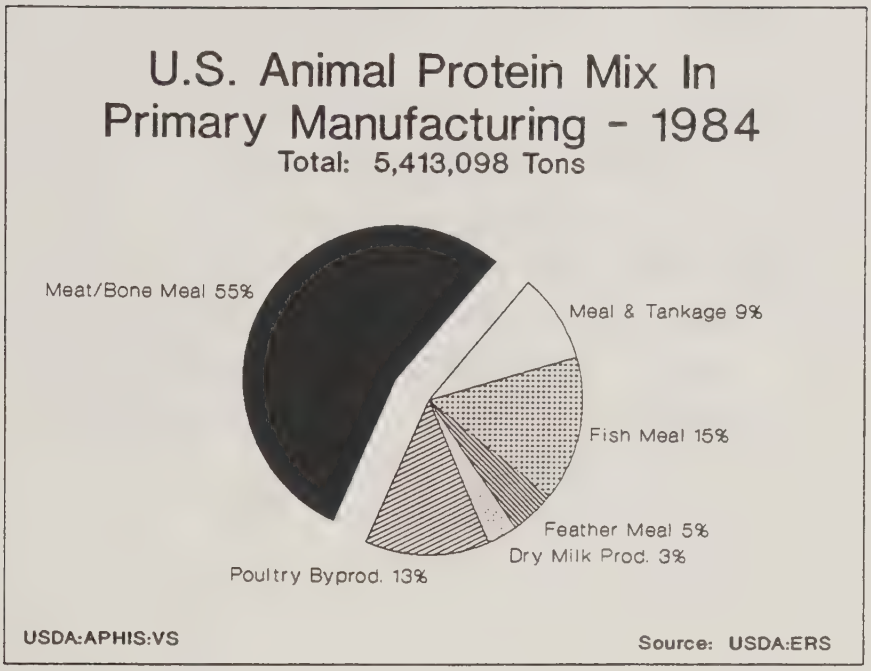


Figure 33



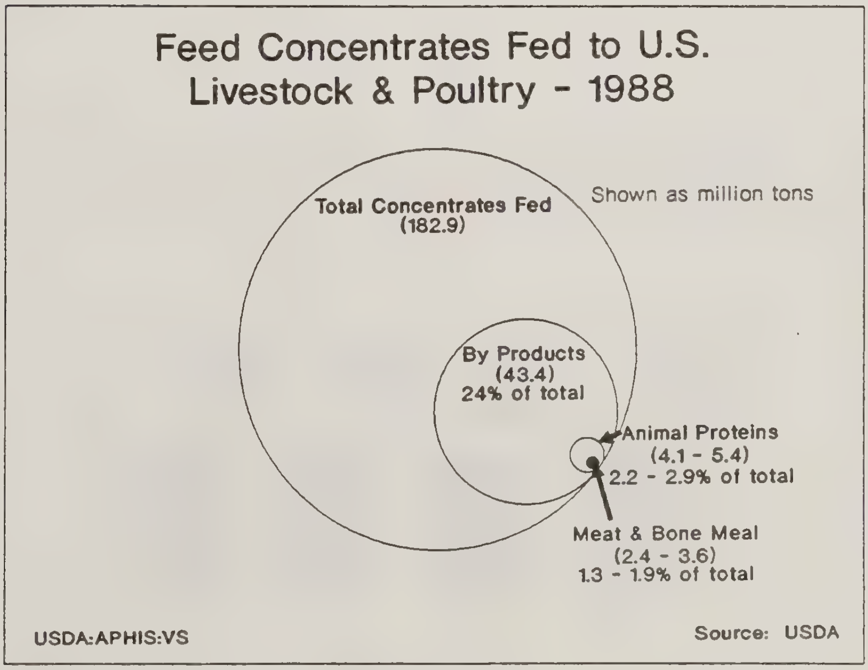
U.S. Animal Protein Mix In Primary Manufacturing - 1984

Total: 5,413,098 Tons

USDA:APHIS:VS

Source: USDA:ERS

Figure 34



Feed Concentrates Fed to U.S. Livestock & Poultry - 1988

USDA:APHIS:VS

Source: USDA

Figure 35

U.K. Production of Feed Concentrates and Animal Inventories - 1988

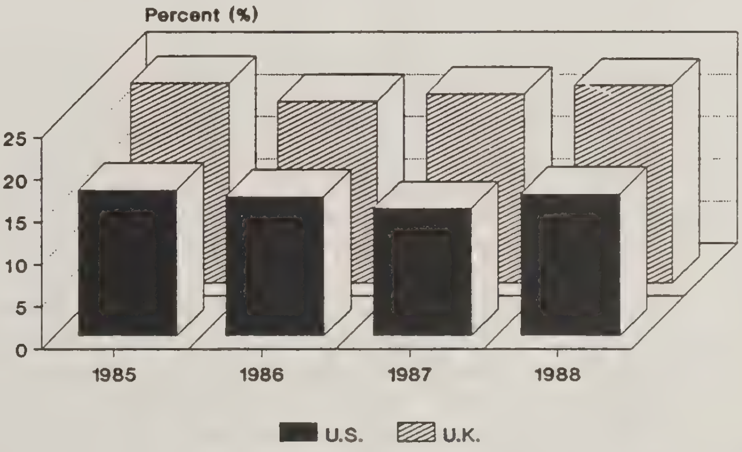
	Concentrates (thousand tons)	Animal Inventories (thousand head)
All Cattle-All Feed	4,038.8	11,872
Dairy Cows-Dairy Feed	2,706.0	2,911
All Sheep-All Feed	413.8	40,942

USDA:APHIS:VS

Source: MAFF, United Kingdom

Figure 36

Animal Proteins as a Percent of Major Oilseed Cake & Meal* Feed Components



USDA:APHIS:VS

*Includes soybean, sunflower, linseed, cotton seed and rapeseed meals

Qualitative Assessment

Considering the comparative factors presented, with the exception of some similarities in rendering practices, epidemiologic factors believed conducive to the introduction of BSE in the United Kingdom are significantly different in the United States. This is supported by the following points:

- Similar changes in the rendering practices have occurred in both countries. Continuous rendering accounts for the vast majority of all product produced. From 1977 to 1982, the portion of United Kingdom product rendered using hydrocarbon solvents dropped from 70 percent to 10 percent. Within the United States the decline was at least 5 years earlier with very little if any solvent in current use.

- With respect to sourcing of sheep offal, two important differences remain. First, the "knacker" industry in the United Kingdom benefits from a smaller geographic land base and higher density of all animals. In the United States, 80 percent of the sheep are located in the 17 western States, much of which is sparsely populated with limited agricultural alternatives. Across these large rangeland operations, coyotes provide some of the same fallen stock removal services as knackers. Second, the United States rendering industry does not move the amount of raw material between plants as is reported in the United Kingdom.

- Compared to the United States, the United Kingdom has 4 times as many sheep and 3 times as many mature sheep on a land mass slightly smaller than the State of Oregon. While scrapie continues in the United States, the number of sheep and farms has trended down. In the United Kingdom, little has been done to control scrapie which has been endemic for several hundred years. Several factors have allowed for an increase in the number of scrapie flocks in the last 10 years. This includes an increase of roughly 1.2 million head per year over the last decade, substantial movement of sheep from the highlands to lowlands and the fluid market for the purchase and sale of animals across the country. Note that in the United Kingdom, 55 percent of the sheep are on 47 percent of the farms. This compares with 51 percent of the sheep on 2 percent of the farms in the United States.

- In the United Kingdom, sheep make up 28 percent of ruminant meat production versus 1.5 percent in the United States. Mature sheep account for about 10 percent of sheep slaughter in the United Kingdom versus about 6 percent in the United States. Sheep in the United Kingdom account for about 14 percent of all rendered product versus 0.6 percent in the United States. If rendered mature sheep product went directly to dairy cows, it would amount to 3.4 pounds per head in the United Kingdom versus 2.8 ounces per head in the United States.

- Even though the United States cattle industry is over 8 times greater, the ratio of all sheep to all cattle is 32 times greater in the United Kingdom. Likewise the ratio of all sheep greater than 1 year to all milk cows is 10 times larger in the United Kingdom. The proximity of the two species in the United Kingdom has changed as incentives and milk quotas have led to an increased number of sheep coming in contact with dairy animals. A factor of consideration is the proportion of rendered sheep material available in proximity to the dairy population. Seventy-two percent of England and Wales' sheep operations contain 81 percent of the sheep and 50 percent of the beef and dairy. In the United States, 58 percent of the sheep operations contain 59 percent of the sheep but only 4.5 percent of the cattle.

- About 98 percent of the BSE cases have been in dairy herds. Herd size distribution is more skewed in the United States with 24 percent of the cows on 2 percent of the herds of 200 plus head. This size class has the highest case rate computed as 329 affected herds per 10,000 herds and is consistent with higher concentrate usage associated with larger herd size. Per 100 pounds of milk produced the United States feeds 41 pounds of concentrate versus 21 pounds in the United Kingdom. However, to measure potential risk from sheep meat and bone meal, the ratio of dairy concentrate fed to mature sheep meat and bone meal produced must be considered, where the larger the ratio the greater the dilution and the less the potential risk. For the United States, the ratio is 34,760:1 or over 17 tons of dairy concentrate fed to each pound of sheep meat and bone meal produced. For the United Kingdom the ratio is 778:1.

- Because of the purported long incubation period of the BSE agent, the average age of dairy cows becomes critical. In the United States, the average age is 3.8 years or 53 percent of all dairy cows are less than 4 years of age. In the United Kingdom, the average age is 5.1 years with 70 percent of dairy cows greater than 4 years. Note that 89 percent of the reported BSE cases are cows 4 years of age or older.

- The usage and composition of concentrates varies greatly across the two countries. The United States feeds far more concentrates and has an abundance of plant based proteins such as soybean meal and cottonseed meal. The United Kingdom has traditionally exported up to 5 percent of meat and bone meal produced and imported 500-600,000 tons of soybeans. Moreover, the portion of animal proteins used as a percent of all other major feed proteins has been 6-7 percent less in the United States than United Kingdom. Also critical has been the inclusion of meat and bone meal as a protein source in United Kingdom calf starter feeds. Comparable feeds in the United States are believed to contain plant based proteins.

While this qualitative analysis suggests that the potential risk of BSE at the aggregate level is substantially less in the United States than the United Kingdom, recognition of potential variation in the levels of risk factors across geographic areas does not occur. Of further consideration are factors such as the concentration of mature sheep slaughter, rendered products produced, and the proximity of rendered products from mature sheep offal to dairy populations. Also, comparative usage of specific technologies in the rendering industry and verification of the usage of animal proteins in calf starter feeds. A more indepth quantitative analysis of these and other factors are contained in the APHIS-VS Quantitative Risk Assessment of BSE in the United States.

List of Figures

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